CONSTRUCTION MASTER IV ®

For Today's Construction Professional

CALCULATED INDUSTRIES

DIAG 48-11 3/16
FEET   INCH

CONSTRUCTION MASTER **IV**

Off	On/C

Pitch	Rise	Run	Diag	Hip/V
Bd Ft	Stair	Circ	Weight	Jack
Cu	Sq	m	cm	mm
Yds	Feet	Inch	/	

Conv	7	8	9	÷
Rcl	4	5	6	×
M+	1	2	3	+
%	0	•	=	−

User's Guide

CALCULATED INDUSTRIES INC.

We put answers at your fingertips
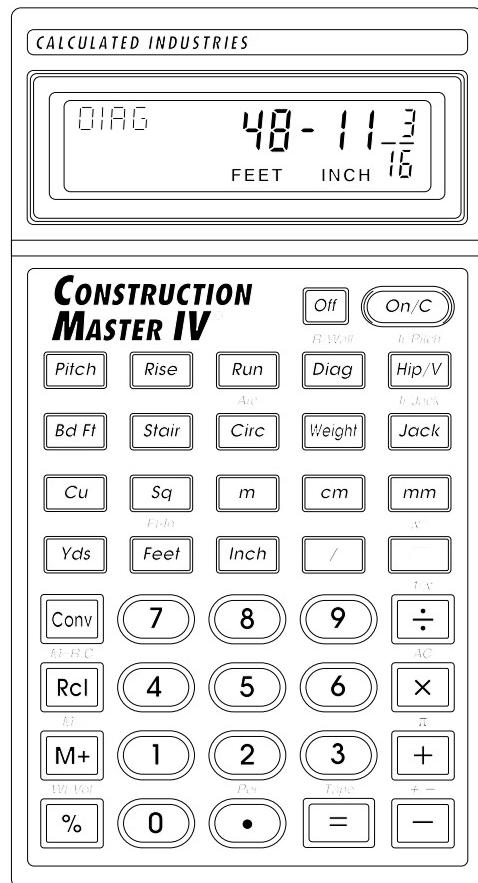
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THE CONSTRUCTION MASTER IV

Designed for today's construction professional, the all-new *Construction Master IV®* adds even more power and ease of use to the already powerful *Construction Master* line-up. As with earlier models, the format of this calculator is so simple, even the novice user will find it easy to solve hundreds of dimension-related problems right in feet, inches and fractions!

- ♦ Solve Dimensional Math
- ♦ English/Metric Conversions
- ♦ Calculate Areas/Volumes
- ♦ Solve Right-Triangle Problems
- ♦ Find Regular & Irregular Hip, Valley and Jack Rafters
- ♦ Calculate Stair Risers, Treads & Stringers
- ♦ Solve Raked Wall Stud Lengths
- ♦ Volume/Weight Conversions
- ♦ Estimate Board Feet
- ♦ Find Circular Areas, Circumferences & Arcs
- ♦ Material Estimations
- ♦ Paperless Tape Function
- ♦ And much, much more!

GETTING STARTED

Key Definitions/Functions

Basic Function Keys

[+] [–] [x] [÷] [=]
Arithmetic operation keys.

[%]
Four-function percent key.

[0] – [9] and **[•]**
Digits used for keying-in numbers.

[Off] — Off Key
Turns all power off, clearing all non-permanent registers.

[On/C] — On/Clear Key
Turns on power. Pressing once clears the display. Pressing twice clears all temporary values.

[Conv] — Convert Key
Used with the dimensional keys to convert between dimensions or with other keys to access special functions.

[√⎺⎺] — Square Root Key

Used to find the square root of a non-dimensional or area value.

[Conv] [√⎺⎺] — x^2 Function

Finds the square of a linear or non-dimensional value.

[M+] — Memory Key

Adds the displayed value to Memory. Clears when the calculator is shut off.

[Conv] [M+] — Memory Minus (M–)

Subtracts the displayed value from Memory.

[Rcl] — Recall Key

Used with other keys to *recall* stored values and settings.

[Rcl] [x] — Imperial/Metric Mode

Changes the defaults of the calculator by setting to Imperial (English) or Metric mode. ***Note: This setting is not affected by the ALL CLEAR function.***

[Conv] [Rcl] — Memory Clear

Clears Memory without changing current display.

Dimension Keys

[Weight] — Weight Key

Enters or converts (a volume value) to *tons*, *pounds*, *metric tons* or *kilograms*. Repeated presses will cycle through these units.

[Conv] [%] — Weight/Volume

Enters or converts the *Weight per Volume* setting as *Tons/Yard³*, *Lbs/Yd³*, *Lb/Ft³*, *Metric Ton/m³* or *kg/m³*. Repeated presses will cycle through these settings.

[Cu]   — Cubic Key

Defines a volume (**5 [Cu] [Yds]**).

[Sq]   — Square Key

Defines an area (**5 [Sq] [Feet]**).

[Yds] — Yards Key

Enters or converts to *yards*.

[Feet] — Feet Key

Enters or converts to *feet* as whole or decimal numbers. Also used with the **[Inch]** and **[/]** keys for entering Feet-Inch values (**6 [Feet] 9 [Inch] 1 [/] 2**). Repeated presses toggle between Feet-Inch and Decimal Feet.

[Inch] — Inch Key

Enters or converts to *inches*. Entry can be whole or decimal numbers. Also used with the **[/]** key for entering fractional inch values (**9 [Inch] 1 [/] 2**). Repeated presses during conversions toggle between Fractional and Decimal Inches.

[/] — Fraction Bar Key

Used to enter fractions. Fractions can be entered as proper (1/2, 1/8, 1/16) or improper (3/2, 9/8). If the denominator (bottom) is not entered, the calculator's fractional accuracy setting is automatically used.

[m] — Meter Key

Enters or converts to *meters*.

[cm] — Centimeter Key

Enters or converts to *centimeters*.

[mm] — Millimeter Key

Enters or converts to *millimeters*.

[Bd Ft] — Feet Key

Enters or converts cubic values to *board feet*. One board foot is equal to 144 cubic inches (1 foot x 1 foot x 1 inch).

Right Triangle/Rafter Keys

[Pitch]

This key is used to enter or calculate the pitch (slope) of a roof (or right triangle). Pitch is the amount of "Rise" over 12 inches (1 meter, if metric) of "Run." Pitch may be entered as:

a dimension	9 [Inch] [Pitch]
an angle	30 [Pitch]
a ratio	0.75 [Conv] [Pitch]
a percentage	75 [%] [Pitch]

A pitch entry will remain in permanent storage until revised or reset. A solution will be replaced by its entered value once the calculator is cleared.

[Rise] — Rise Key

Enters or calculates the rise or vertical leg (height) of a right triangle.

[Run] — Run Key

Enters or calculates the run or horizontal leg (base) of a right triangle.

[Diag] — Diagonal Key

Enters or calculates the common or diagonal leg (hypotenuse) of a right triangle. Typical applications are "squaring" slabs or finding common rafter lengths.

[Conv] [Diag] — Raked Walls

This function finds the decreasing stud sizes in a raked wall based on computed or entered values for pitch, rise and/or run. Repeated presses display stud sizes from longest to shortest.

The on-center spacing of a raked wall can be permanently stored by entering a dimension prior to solving for stud sizes (**12 [Inch] [Conv] [Diag]**). Default on-center spacing is 16 inches (Metric Mode: 600 mm).

[Hip/V] — Hip/Valley Rafter Key

Finds the regular or irregular hip/valley rafter length. If an irregular pitch is entered, the irregular hip/valley rafter length is displayed, otherwise the regular (45°) hip/valley rafter length is displayed.

[Conv] [Hip/V] — Irregular Pitch

Enters and displays the irregular pitch value used to calculate lengths of the irregular hip/valley and jack rafters.

[Jack] — Jack Rafter Key

Finds the jack rafter sizes – from largest to smallest – for both regular and irregular pitched roofs. The initial jack rafter values displayed are from the regular pitched side. After showing the minimum value, the calculator will display the sizes for the irregular pitched side. An on-center spacing can be entered by pressing [Jack] (i.e., **12 [Inch] [Jack]**). The default spacing is 16 inches (Metric Mode: 600 millimeters).

[Conv] [Jack] — Irregular Side Jacks

Operates same as **[Jack]**, but displays the irregular pitched side jack rafters first. The calculator uses the same on-center spacing as the regular pitch sided jack rafters unless a new on-center spacing is entered (**19.2 [Inch] [Conv] [Jack]**).

Stair & Circle Keys

[Stair] — Stair Key

A multi-function key that enters a *desired riser height* and uses the rise and run values to compute and display the following:

Press	Result
1	Number of Risers
2	Actual Riser Height
3	Riser Overage/Underage
4	Number of Treads
5	Actual Tread Width
6	Tread Overage/Underage
7	Stringer Length
8	Inclination Angle

Default value is 7-1/2 inches (Metric Mode: 185 millimeters).

[Circ] — Circle

Displays the following values, given an entered diameter:

1) diameter,
2) area, and
3) circumference.

[Conv] [Circ] — Arc Length

Calculates the arc length based on an entered diameter and angle.

Additional [Conv] Key Functions

When used in conjunction with the following keys, the [Conv] key gives access to these additional functions:

[Conv] [÷]

Reciprocal, or 1/x function.

[Conv] [x] — All Clear

Clears all values including Memory. Resets all permanent settings to defaults. ***Note: Will not change the Imperial/Metric mode setting. [Rcl] [x] changes this setting.***

[Conv] [+] — Pi (π)

Constant = 3.141593.

[Conv] [–] — Sign (+ / –) Toggle

Toggles the sign of the displayed value.

[Conv] [=] — Paperless Tape

Accesses the paperless tape mode.

[Conv] [•] — Per Function

Allows you to compute a total material cost given a unit dimension and

an entered *Per Unit Cost.* **Note:** *Board feet calculations are per 1,000 Bdft (Mbm)*

Fractional Settings

Setting Fractional Accuracy

When your calculator is in a default condition (battery change or full reset), it is set to round fractional values to the nearest 1/16th of an inch. The fractional level can be revised by using the following keystrokes:

[Conv] 1	= Accuracy set to 1/<u>16</u>
[Conv] 2	= Accuracy set to 1/<u>2</u>
[Conv] 3	= Accuracy set to 1/<u>32</u>
[Conv] 4	= Accuracy set to 1/<u>4</u>
[Conv] 6	= Accuracy set to 1/<u>64</u>
[Conv] 8	= Accuracy set to 1/<u>8</u>

A star (★) will appear in the bottom left of the display when the calculator is turned on, if the setting is different from the default. The fractional setting can be displayed at any time by pressing **[Rcl] [/]**.

Normal Fractional Mode

(*Default*) In Normal Mode (**[Conv] 7**), the fractional result is reduced to its lowest common denominator (8/16 reduces to 1/2).

Fixed Fractional Mode

In the Fixed Mode (**[Conv] 9**), fractional results are displayed in the calculator's fractional accuracy setting.

Flashing Denominator

Your calculator can be set to flash the fractional accuracy setting in the denominator during entry by pressing **[Conv] [/]**. Pressing **[Conv] [/]** again will turn it off.

Entering Dimensions

Linear Dimensions

When entering feet-inch values, enter dimensions from largest to smallest — feet before inches, inches before fractions. Enter fractions by entering

the numerator (top), pressing **[/]** (fraction bar key) and then the denominator (bottom). ***Note:*** *If a denominator is not entered, the fractional setting value is used.*

Examples of how linear dimensions are entered:

Dimension	Keystrokes
5 Yards	**5 [Yds]**
5 Feet 1-1/2 Inch	**5 [Feet] 1 [Inch]**
	1 [/] 2
17.5 Meters	**17.5 [m]**

Square and Cubic Dimensions

Square & cubic dimensions***** are entered in the following order:
   (1) Numerical Value
   (2) Convention — Square/Cubic
   (3) Unit — Meters, Feet, Inches

Examples of how square and cubic dimensions are entered:

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* Feet-Inch format cannot be used to directly enter square or cubic values.

Dimension	Keystrokes
5 Cubic Yards	**5 [Cu] [Yds]**
130 Square Feet	**130 [Sq] [Feet]**
33 Square Meters	**33 [Sq] [m]**

Linear Conversions

Convert 14 feet to other dimensions:

Keystroke	Display
14 [Feet] . . .	
[Conv] [Yds]	**4.666667 YD**
[Conv] [Feet]	**14 FT 0 IN**
[Conv] [Feet]	**14 FT**
[Conv] [Inch]	**168 IN**
[Conv] [mm]	**4267.2 MM**
[Conv] [cm]	**426.72 CM**
[Conv] [m]	**4.2672 M**

Square Conversions

Convert 14 square feet to other square dimensions:

Keystroke	Display
14 [Sq] [Feet] . . .	
[Conv] [Inch]	**2016 SQ IN**
[Yds] *	**1.555556 SQ YD**
[m]	**1.300643 SQ M**
[mm]	**1300643 SQ MM**
[cm]	**13006.43 SQ CM**

---

* When performing conversions, [Conv] only has to be pressed once.

Cubic Conversions

Convert 14 cubic feet to other cubic dimensions:

Keystroke	Display
14 [Cu] [Feet] . . .	
[Conv] [Inch]	**24192 CU IN**
[Yds]	**0.518519 CU YD**
[m]	**0.396436 CU M**
[cm]	**396435.9 CU CM**
[mm] *	**0.396436 CU M**

Basic Math Operations

Your calculator uses standard chaining logic, which simply means that you enter your first value, the operator (+, –, x, ÷), the second value and then the Equals sign ("=").

A.	3	[+]	2	[=]	5
B.	3	[–]	2	[=]	1
C.	3	[x]	2	[=]	6
D.	3	[÷]	2	[=]	1.5

* The calculator's auto-range function forced the answer to be in meters, as it is out of the calculator's normal 7-digit range (See Appendix A–Auto-Range).

This feature also makes the calculator simple to use for dimensional applications:

Adding Dimensions

Add 11 inches to 2 feet 1 inches:

11 [Inch] [+] 2 [Feet] 1 [Inch] [=] *   **36 IN**

Add 2 feet 1 inches to 11 inches:

2 [Feet] 1 [Inch] [+] 11 [Inch] [=]   **3 FT 0 IN**

Subtracting Dimensions

Subtract 3 feet from 11 feet 7-1/2 inches:

11 [Feet] 7 [Inch] 1 [/] 2
[–] 3 [Feet] [=]   **8 FT 7-1/2 IN**

Subtract 32 inches from 81 inches:

81 [Inch] [–] 32 [Inch] [=]   **49 IN**

---

* *The format of the first value entered determines the answer format. [Conv] can be used to change to any format desired, provided convention is maintained.*

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Multiplying Dimensions

Multiply 5 feet 3 inches by 11 feet 6-1/2 inches:
5 [Feet] 3 [x] 11 [Feet]
6 [Inch] 1[/] 2 [=]   **60.59375 SQ FT**

Multiply 2 feet 7 inches by 10:
2 [Feet] 7 [Inch] [x] 10 [=]   **25 FT 10 IN**

Dividing Dimensions

Divide 30 feet 4 inches by 7 inches:
30 [Feet] 4 [Inch] [÷] 7 [Inch] [=]   **52**

Divide 20 feet 3 inches by 9:
20 [Feet] 3 [Inch] [÷] 9 [=]   **2 FT 3 IN**

Percentage Calculations

The Percent [%] key can be used for finding a given percent of a number or for working add-on, discount or division percentage calculations. It can be used with any type of number, in any dimension (feet, inch, millimeter, etc) and any type of convention (non-dimensioned, linear, square or cubic).

Computing Percentages

Find 18% of 500 feet:

500 [Feet] [x] 18 [%]   **90 FT 0 IN**

Add 10% to 137 square feet:

137 [Sq] [Feet] [+] 10 [%]   **150.7 SQ FT**

Take 20% from 552 feet 6 inches:

552 [Feet] 6 [Inch] [–] 20 [%]   **442 FT 0 IN**

Divide 350 cubic yards by 80%:

350 [Cu] [Yds] [÷] 80 [%]   **437.5 CU YD**

Memory Operation

Whenever the **[M+]** key is pressed, the displayed value will be added to the Memory. Other memory functions:

Function	Keystrokes
Add to Memory	[M+]
Subtract from Memory	[Conv] [M+]
Recall total in Memory	[Rcl] [M+]
Display/Clear Memory	[Rcl] [Rcl]
Clear Memory	[Conv] [Rcl]
Replace Memory	[Conv] [Rcl] [M+]

Memory is semi-permanent, clearing only when you:

1) turn off the calculator;
2) press **[Rcl] [Rcl]**;
3) press **[Conv] [Rcl]**;
4) press **[Conv] [x]** (all clear).

How to Use Memory Functions:

Keystroke	Display
355 [M+]	**355**. Ⓜ
255 [M+]	**255**. Ⓜ
745 [Conv] [M+]	**745**. Ⓜ
[Rcl] [Rcl]	**– 135.**
10 [Feet] 5 [Inch] [M+]	**10 FT 5 IN** Ⓜ
5 [Feet] 3 [Inch] [M+]	**5 FT 3 IN** Ⓜ
[Rcl] [Rcl]	**15 FT 8 IN**

Paperless Tape

The Paperless Tape allows the user to display and review the last 20 entries of a calculation. **[Rcl] [=]** accesses the tape mode and **[+]** or **[–]** scrolls forward or backward through the entries.

While in the Paperless Tape mode, the display will show the entered or calculated value, along with the sequence number of entry (e.g., **01**, **02**, **03**, etc.) and the math operator (+, –, **x**, ÷, **%**) in the upper left corner of the display. If **[=]** has been used in the middle of a string, **SUB** (for Subtotal) will display in the upper left. If **[=]** was the last operation performed, the display will show **TTL** (Total) as the last entry.

Pressing any key other than [Off], [+] or [–] exits the Paperless Tape mode. The last entry made (or **TTL**) will be displayed, allowing you to either exit completely, or to continue using the last tape value for another operation.

Note: The Paperless Tape is cleared each time [On/C] is pressed twice, or the unit is shut off.

Previewing Paperless Tape

Keystroke	Display
1. Enter a string of numbers:	
4 [Feet] [+]	**4 FT 0 IN**
5 [Feet] [+]	**9 FT 0 IN**
6 [Feet] [+]	**15 FT 0 IN**
7 [Feet] [=]	**22 FT 0 IN**
2. Access the Tape function:	
[Rcl] [=]	**TTL= 22 FT 0 IN**
3. Scroll from first value to total:	
[+]	**01 4 FT 0 IN**
[+]	**02+ 5 FT 0 IN**
[+]	**03+ 6 FT 0 IN**
[+]	**04+ 7 FT 0 IN**
[+]	**TTL= 22 FT 0 IN**
4. Scroll to last 2 values:	
[–]	**04+ 7 FT 0 IN**
[–]	**03+ 6 FT 0 IN**
5.Exit Tape function and continue:	
[=] *****	**TTL= 22 FT 0 IN**
[+]	**22 FT 0 IN**
2 [Feet] [=]	**24 FT 0 IN**

* Can press any key besides [Off], [+] or [–].

Linear Calculations

Spacing Calculation — Lumber

How many 2 feet 2 inch pieces can be made from fifteen 10 foot boards?

Keystroke	Display
1. Divide board length by smaller cuts	
[On/C] [On/C]	**0.**
10 [Feet]	**10 FT**
[÷] 2 [Feet] 2 [Inch] [=]	**4.615385**
	(or 4 whole boards)
2. Find total boards	
4 [x] 15 [=]	**60** (pieces)

Carpentry — Calculating the Number of Studs

Find the number of 16 inch on-center studs needed for a 18 feet 7-1/2 inch wall.

Keystroke	Display
1. Divide length by spacing	
[On/C][On/C]	**0.**
18 [Feet] 7 [Inch] 1 [/] 2	**18 FT 7 1/2 IN**
[÷] 16 [Inch] [=]	**13.96875** (14 studs)
2. Add one for the end	
[+] 1 [=]	**14.96875** (15 studs)

Note: Also applies to trusses and joists.

Masonry — Estimating Bricks

How many standard bricks (3-3/4 inch by 8 inch) are required for a 36.5 feet by 8 feet wall?

Keystroke	**Display**

1. Find Brick Area

| [On/C] [On/C] | **0.** |
| 3 [Inch] 3[/] 4 [x] 8 [Inch] [=] | **30 SQ IN** |

2. Store in Memory and Find Wall Area

| [M+] | **30 SQ IN** |
| 36.5 [Feet] [x] 8 [Feet] [=] | **292 SQ FT** |

3. Divide by brick area to find total bricks

| [÷] [Rcl] [M+] [=] | **1401.6** (Bricks) |

4. Add 5% for spoilage

| [+] 5 [%] | **1471.68** (1472 Bricks) |

Area Calculations

Area of a Rectangle

What is the area of a room measuring 12 feet 6 inches by 15 feet 8 inches?

Keystroke	Display
[On/C] [On/C]	**0.**
12 [Feet] 6 [Inch]	**12 FT 6 IN**
[x] 15 [Feet] 8 [Inch] [=]	**195.8333 SQ FT**

Area of a Square

Using the x^2 ([Conv][$\sqrt{}$]) function, find the area of a square with sides of 4 feet 7 inches.

Keystroke	Display
[On/C] [On/C]	**0.**
4 [Feet] 7 [Inch]	**4 FT 7 IN**
[Conv][$\sqrt{}$]	**21.00694 SQ FT**

Area — Floor Covering

You have an apartment with two rooms of carpet that need to be replaced. The room dimensions are as follows: 12 feet 4 inches by 10 feet and 14 feet 8 inches by 16 feet. How many square yards of carpet are needed and what is the total cost at $11.75 per square yard?

Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Area of Room 1 & Add to Memory

12 [Feet] 4 [Inch]	**12 FT 4 IN**
[x] 10 [Feet] [=] [M+]	**123.3333 SQ FT**
Enter in Memory	

2. Find Area of Room 2 & Add to Memory

14 [Feet] 8 [Inch]	**14 FT 8 IN**
[x] 16 [Feet] [=] [M+]	**234.6667 SQ FT**

3. Find Total Area and Cost

[Rcl] [Rcl] [Conv] [Yds]	**39.77778 SQ YD**
[x] 11.75 [Conv] [•]	**$467.39**

Roof Covering — No. of Shingles

You're going to use 12 inch wide by 36 inch long asphalt (strip) shingles with 5 inch weather exposure. How many shingles are required for a 1745 square foot roof? (***Note:** Shingle exposure area = Exposure x length, and Number of Shingles = Roof area ÷ shingle exposure area.*)

Keystroke	Display

1. Find and save shingle exposure area

[On/C] [On/C]	**0.**
5 [Inch] [x] 36 [Inch] [=]	**180 SQ IN**
[M+]	**180 SQ IN**

2. Find Total Shingles Required

1745 [Sq] [Feet]	**1745 SQ FT**
[÷] [Rcl] [Rcl] [=]	**1396** (shingles)

3. Add 10% for waste

[+] 10 [%]	**1535.6** (1536 shingles)

Volume Calculations

Rectangular Containers

What is the volume of a container 3 feet by 1 foot 9-5/8 inches by 2 feet 4 inches? (LxWxH)

Keystroke	Display
[On/C] [On/C]	**0.**
3 [Feet]	**3 FT**
[x] 1 [Feet] 9 [Inch] 5 [/] 8	**1 FT 9 5/8 IN**
[x] 2 [Feet] 4 [Inch] [=]	**12.61458 CU FT**

Volume of a Cylinder

You want to calculate the volume of a cylinder with a diameter 2 feet 4 inches and a height of 4 feet 6 inches.

Keystroke	Display
[On/C] [On/C]	**0.**
2 [Feet] 4 [Inch]	**2 FT 4 IN**
[Circ] [Circ]	**AREA 4.276057 SQ FT**
[x] 4 [Feet] 6 [Inch] [=]	**19.24225 CU FT**

Simple Concrete Volume

You're going to form up and pour your own driveway and you need to accurately calculate the cubic yards of concrete required for the job. The measurements are as follows: 36 feet 3 inches long by 11 feet 6 inches wide by 4 inches deep. What's the volume of your driveway, and if concrete costs $55 per cubic yard, how much will your concrete cost you?

Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Volume

36 [Feet] 3 [Inch]	**38 FT 3 IN**
[x] 11 [Feet] 6 [Inch]	**11 FT 6 IN**
[x] 4 [Inch] [=]	**138.9583 CU FT**
[Conv] [Yds]	**5.146605 CU YD**

2. Multiply by Cost

[x] 55 [Conv] [•]	**$ 283.06 Per**

Concrete Columns

You're going to pour five columns, each of which has a diameter of 3 feet 4-1/2 inches and a height of 11 feet 6 inches. How many cubic yards of concrete will you need for all five columns?

Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Surface Area of Column

3 [Feet] 4 [Inch] 1 [/] 2	**3 FT 4 1/2 IN**
[Circ] [Circ]	**AREA 8.946176 SQ FT**

2. Find Total Volume

[x] 11 [Feet] 6 [Inch] [=]	**102.881 CU FT**
[Conv] [Yds]	**3.810408 CU YD**
[x] 5 [=]	**19.05204 CU YD**

Complex Concrete Volume

You're going to pour an odd-shaped patio 4-1/2 inches deep with the dimensions shown below. First, calculate the total area (by dividing the drawing into three individual rectangles) and then determine the total yards of concrete required for this job.
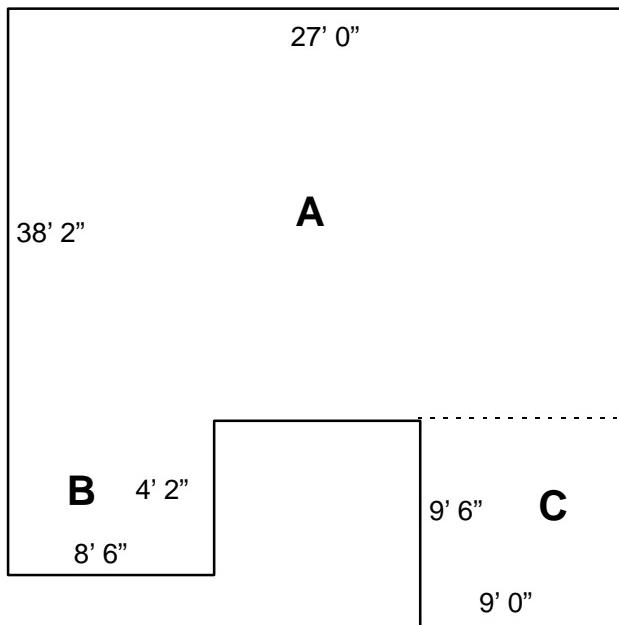
Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Area of Part A

38 [Feet] 2 [Inch] [–]	
4 [Feet] 2 [Inch] [=]	**34 FT 0 IN**
[x] 27 [Feet] [=]	**918 SQ FT**
[M+]	

2. Find Area of Part B

4 [Feet] 2 [Inch]	**4 FT 2 IN**
[x] 8 [Feet] 6 [Inch] [=]	**35.41667 SQ FT**
[M+]	

3. Find Area of Part C

9 [Feet]	**9 FT**
[x] 9 [Feet] 6 [Inch] [=]	**85.5 SQ FT**
[M+]	

4. Find Total Area

[Rcl] [Rcl]	**1038.917 SQ FT**

5. Find Total Cubic Yards

[x] 4 [Inch] 1 [/] 2 [=]	**389.5937 CU FT**
[Conv] [Yds]	**14.4294 CU YD**

Volume / Weight Calculations

Concrete Footing

Find the total volume* of concrete required to pour five 24 inch by 12 inch footings, each 2 feet deep. Then find the weight of the concrete (use 1.5 tons per cubic yard).

Keystroke	Display
[On/C] [On/C]	**0.**

1. Enter Weight Per Volume

1.5 [Conv] [%] †	**1.5 Tons Per CU YD**

2. Find Volume of Footings

2 [Feet]	**2 FT**
[x] 24 [Inch]	**24 IN**
[x] 12 [Inch] [=]	**4 CU FT**
[Conv] [Yds]	**0.148148 CU YD**
[x] 5 [=]	**0.740741 CU YD**

3. Find the Weight of Concrete

[Conv] [Weight]	**1.111111 Ton**
[Weight]	**2222.222 LB**
[Weight]	**1.008 M Ton**
[Weight]	**1007.983 KG**

** **S**ee Appendix B for other geometric shape formulas.*

† Continue pressing the [%] key if the units are not shown as Tons/Yd³

Board Feet/
Lumber Calculations

Board Feet and lumber problems can easily be solved with the *Construction Master IV's* built-in Board Feet and material estimating function.

Total Board Feet
— *With Dollar Cost*

Find the total board feet for one each of the following sizes:

2 x 4 x 14

2 x 10 x 16

2 x 12 x 18

In addition, if this board cost $250 per Mbm., how much will this order cost?

Keystroke	Display
[On/C] [On/C]	**0.**
2 [x] 4 [x] 14 [BdFt] [M+]	**9.333333 B FT**
2 [x] 10 [x] 16 [BdFt] [M+]	**26.66667 B FT**
2 [x] 12 [x] 18 [BdFt] [M+]	**36 B FT**
[Rcl] [Rcl]	**72 B FT**
[x] 250 [Conv] [•]	**$ 18.00 Per**

Right-Triangle Calculations

The top row of keys provide you with built-in solutions to right triangles. The solutions are available in any of the linear dimensions offered on the calculator. Thus, you can solve right triangles directly in feet and inches, decimal feet, meters, etc.

Any value of a right triangle can be found given two of the four variables: 1) Rise, 2) Run, 3) Diagonal or 4) Pitch.

Pitch is a permanent entry that can be entered as the Rise per foot (meter for Metric Mode), as an angle, or as a ratio/percentage ([Conv] [Pitch]).

Right Triangle:
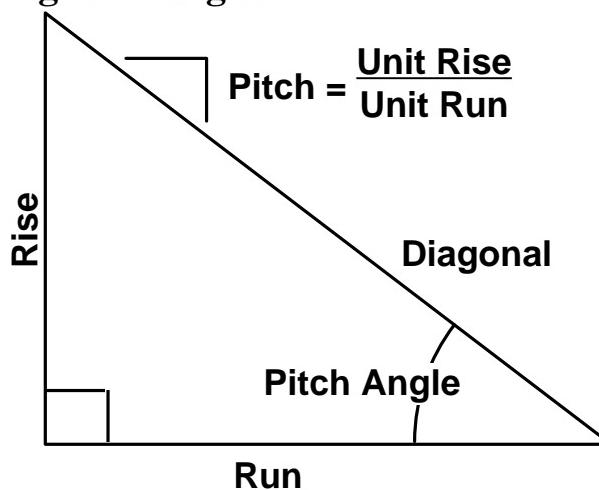
Squaring a Concrete Slab

Assume you want to "square-up" the forms for a concrete foundation measuring 45 feet 6 inches by 24 feet 4 inches. In order for the forms to be square, what should the diagonal measurements (Square-Up) be?
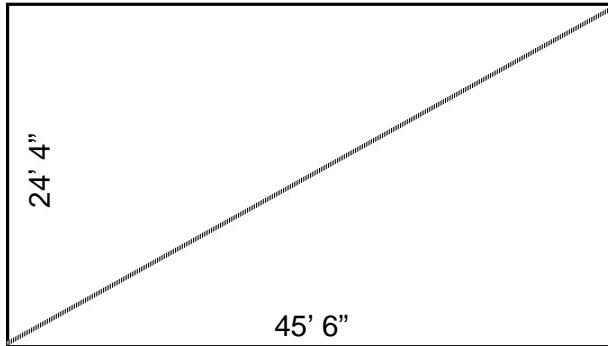
Keystroke	Display
[On/C] [On/C]	**0.**

1. Enter Sides as Rise/Run

| 45 [Feet] 6 [Inch][Run] | **RUN   45 FT 6 IN** |
| 24 [Feet] 4 [Inch][Rise] | **RISE   24 FT 4 IN** |

2. Find the Square Up (Diagonal)

| [Diag] | **DIAG   51 FT 7-3/16 IN** |

Back-Fill on a Slope
with Percent of Grade Known

You've built 55 linear feet of a three-foot high retaining wall 3 feet out from the base of a 65% grade. You plan to back-fill to within 12 inches of the top of the wall (for a 2' depth). How many cubic yards of fill should you have delivered?
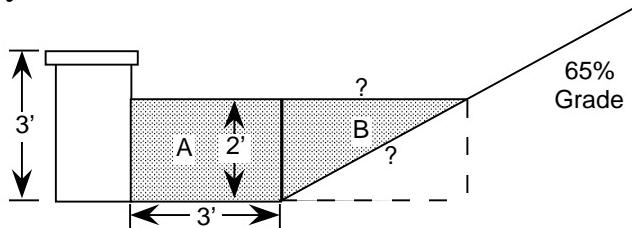
Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Volume for "A"

55 [Feet]	**55 FT**
[x] 3 [Feet]	**3 FT**
[x] 2 [Feet] [=] [M+]	**330 CU FT**

2. Find Run/Diagonal of "B"

65 [%] [Conv][Pitch]	**PTCH 0.65**
2 [Feet] [Rise]	**RISE 2 FT**
[Run]	**RUN 3 FT 0-15/16 IN**
[Diag]	**DIAG 3 FT 8-1/16 IN**

3. Find Volume of Triangle "B"

55 [Feet]	**55 FT**
[x] 3 [Feet] 15 [/] 16	**3 FT 0-15/16 IN**
[x] 2 [Feet] [=]	**338.5938 CU FT**
[÷] 2 [=] [M+]	**169.2969 CU FT**

4. Find Total Volume

[Rcl] [Rcl]	**499.2969 CU FT**
[Conv] [Yds]	**18.49248 CU YD**

Area for Roofing Materials

You're ordering roofing materials for a roof with a 5/12 Pitch, an overall span of 27 feet and a length of 34 feet 6 inches. How many squares, at 100 square feet each, are there?

Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Common Rafter Length

5 [Inch] [Pitch]	**PTCH 5 IN**
27 [Feet] [÷] 2 [=] [Run]	**RUN 13 FT 6 IN**
[Diag]	**DIAG 14 FT 7-1/2 IN**

2. Find Area of One Side

[x] 34 [Feet] 6 [Inch] [=]	**504.5625 SQ FT**

3. Find Area of Both Sides

[x] 2 [=]	**1009.125 SQ FT**

4. Find Number of Squares

[÷] 100 [Sq] [Feet][=]   **10.09125** (squares)

Common Rafter Length
— (*Pitch Known*)

The roof you are working on has a 7/12 Pitch, with a span of 23 feet 6 inches. What length should you cut the Common rafters (not counting the overhang or ridge adjustments)?

7/12 Pitch

23' 6"
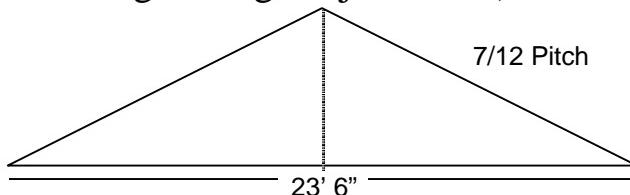
Keystroke	Display
[On/C] [On/C]	**0.**
7 [Inch] [Pitch]	**PTCH 7 IN**
23 [Feet] 6 [Inch] [÷] 2 [=]	**11 FT 9 IN**
[Run]	**RUN 11 FT 9 IN**
[Diag]	**DIAG 13 FT 7-1/4 IN**

Common Rafter— (*Pitch Unknown*)

You're unsure of the roof pitch but know the Rise is 6 feet 11-1/2 inches and the Run is 14 feet 6 inches. Find the Common rafter length. Then solve for the Pitch.

Keystroke	Display
[On/C] [On/C]	**0.**

Find Diagonal & Pitch

6 [Feet] 11 [Inch] 1 [/] 2	
[Rise]	**RISE 6 FT 11-1/2 IN**
14 [Feet] 6 [Inch] [Run]	**RUN 14 FT 6 IN**
[Diag]	**DIAG 16 FT 1 IN**
[Pitch]	**PTCH 25.63565°**
[Pitch]	**PTCH 5-3/4 IN**

Note: If the Pitch is displayed in degrees, just press [Pitch] again to display the rise per unit run value.

Finding Rise —
(*Pitch and Run Known*)

Though not commonly asked for, you can compute the rise or run of a right angle just as you would the diagonal. Find the rise given a 7/12 pitch and a run of 11 feet 6 inches:

Keystroke	Display
[On/C] [On/C]	**0.**
7 [Inch] [Pitch]	**PTCH 7 IN**
11 [Feet] 6 [Inch] [Run]	**RUN 11 FT 6 IN**
[Rise]	**RISE 6 FT 8-1/2 IN**

Finding Rise & Diagonal —
(*Degrees of Pitch & Run Known*)

Find the Rise and Diagonal sides of a right angle given a 30° Pitch and a Run of 20 feet 5 inches:

Keystroke	Display
[On/C] [On/C]	**0.**
30 [Pitch]	**PTCH 30°**
20 [Feet] 5 [Inch] [Run]	**RUN 20 FT 5 IN**
[Rise]	**RISE 11 FT 9-7/16 IN**
[Diag]	**DIAG 23 FT 6-7/8 IN**

Raked Wall – Stud Sizes

Find each stud size in a raked wall with a peak of 15 feet 5 inches, and a length of 30 feet 7 inches. Use 16 inches as your on-center spacing.

Keystroke	Display
[On/C] [On/C]	**0.**

Enter Rise, Run and O.C. Spacing

15 [Feet] 5 [Inch] [Rise]	**RISE 15 FT 5 IN**
30 [Feet] 7 [Inch] [Run]	**RUN 30 FT 7 IN**
16 [Inch][Conv] [Diag]	**OC 16 IN**

Find Stud Lengths

[Conv] [Diag]	**RW 1 14 FT 8-15/16 IN**
[Diag]	**RW 2 14 FT 0-7/8 IN**
[Diag]	**RW 3 13 FT 4-13/16 IN**
[Diag]	**RW 4 12 FT 8-3/4 IN**
[Diag]	**RW 5 12 FT 0-11/16 IN**

Etc......Continue pressing [Diag] until last stud size or "0" is reached.

Hip/Valley & Jack Rafters

The *Construction Master IV* uses the rise, run, diagonal, pitch and o.c. spacing values to compute *regular* (45°) and *irregular* (non-45°) hip/valley and jack rafter lengths (*excluding wood thickness, etc.*).

"Regular" Hip/Valley & Jack Rafters:

To solve for regular (45°) hip/valley and jack rafter lengths, press [Hip/V] and then [Jack]. Repeated presses of [Jack] will compute all regular jack rafters – from longest to shortest size.

"Irregular" Hip/Valley & Jack Rafters:

To solve for *irregular* (non-45°) hip/valley and jack rafter lengths, enter the irregular pitch using [Conv] [Hip/V] (**10 [Inch] [Conv] [Hip/V]**). Press the [Hip/V] key again to find the length of the irregular hip/valley rafter. Then press [Jack] to compute the size of the longest irregular jack rafter on the common pitch side. Successive presses of [Jack] will display each decreasing jack size.

Additional presses of [Jack], once "0" is reached, will cause your calculator to "revolve," or display the rafter sizes on the opposite side of the hip/valley rafter (i.e., the Irregular Pitch Side). Pressing [Conv] [Jack] will start the display sequence using the longest rafter size on the irregular pitch side.
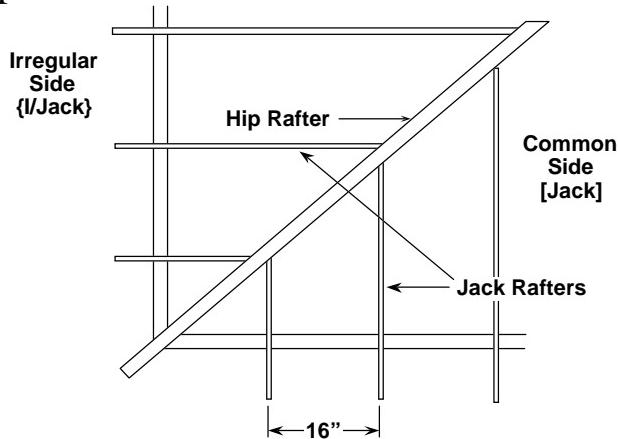
When calculating regular and irregular jack rafter lengths, you will see the letters "**JK**" (common pitch) or "**IJ**" (irregular pitch) with the corresponding Jack number to the left of your calculator display. This will enable you to keep track of the descending sizes, and which side the corresponding rafter is based on.

Regular (45°) Hip/Valley & Jack Rafters

You're working with a 7/12 Pitch, and half your total span is 13 feet 9 inches: (A) Find the point-to-point length for the common rafter; (B) Find the length of an adjoining hip (or valley) and; (C) Find the lengths of the regular jack rafters (jack rafters at 16" on-center spacing).

Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Common Rafter Length

13 [Feet] 9 [Inch] [Run]	**RUN 13 FT 9 IN**
7 [Inch] [Pitch]	**PTCH 7 IN**
[Diag]	**DIAG 15 FT 11 IN**

2. Find Hip Rafter Length

[Hip/V]	**H/V 21 FT 0-7/16 IN**

3. Find Jack Rafter Lengths

16 [Inch] [Jack]	**OC 16 IN**
[Jack]	**JK1 14 FT 4-1/2 IN**
[Jack]	**JK2 12 FT 10 IN**
[Jack]	**JK3 11 FT 3-7/16 IN**

Etc......Continue pressing [Jack] until last Jack is reached or until display shows "0."

Jack Rafters — (*with other than 16 inch on-center spacing*)

You're working with a roof having a 7/12 pitch and a run of 30 feet 9 inches. Find the jack rafter lengths at 18 inch on-center spacing.

Keystroke	Display
[On/C] [On/C]	**0.**

1. Enter Pitch, Run and Spacing

7 [Inch] [Pitch]	**PTCH 7 IN**
30 [Feet] 9 [Inch] Run]	**RUN 30 FT 9 IN**
18 [Inch] [Jack]*	**OC 18 IN**

2. Find Jack Rafter Lengths

[Jack]	**JK1 33 FT 10-3/8 IN**
[Jack]	**JK2 32 FT 1-1/2 IN**
[Jack]	**JK3 30 FT 4-11/16 IN**

Etc......Continue pressing [Jack] until last Jack is reached or until display shows "0."

---

* If the entered value is not dimensioned, the calculator will assume the value as inches for English and millimeters for Metric calculations.

Irregular (non-45°) Hip/Valley & Jack Rafters

You're working with a 7/12 pitch and half your overall span is 15 feet 7 inches. The irregular pitch is 8/12:

- (A) Find the point-to-point length for the common rafter;

- (B) Find the length of the adjoining "irregular" hip (or valley);

- (C) Find the jack lengths on the "irregular" pitch side (16″ o.c. spacing);

- (D) Find the jack lengths on the "regular" pitch side (16″ o.c. spacing).

Keystroke	Display
[On/C] [On/C]	**0.**

1. Find Common Rafter Length

7 [Inch] [Pitch]	**PTCH 7 IN**
15 [Feet] 7 [Inch][Run]	**RUN 15 FT 7 IN**
[Diag]	**DIAG 18 FT 0-1/2 IN**

2. Find Irregular Hip Rafter Length

8 [Inch] [Conv][Hip/V]	**IPCH 8 IN**
[Hip/V]	**IH/V 22 FT 7-3/8 IN**

3. Find Irregular Jack Lengths

16 [Inch] [Conv] [Jack]	**OC**	**16 IN**
[Conv] [Jack]	**IJ1**	**14 FT 11-13/16 IN**
[Jack] *	**IJ2**	**13 FT 7 IN**
[Jack]	**IJ3**	**12 FT 2-3/16 IN**
[Jack]	**IJ4**	**10 FT 9-3/8 IN**
[Jack]	**IJ5**	**9 FT 4-1/2 IN**

Etc......Continue pressing [Jack] until last regular jack or "0." is reached.

4. Find Regular Jack Lengths

16 [Inch] [Jack]	**OC**	**16 IN**
[Jack]	**JK1**	**16 FT 3-5/16 IN**
[Jack]	**JK2**	**14 FT 6-1/8 IN**
[Jack]	**JK3**	**12 FT 9 IN**
[Jack]	**JK4**	**10 FT 11-13/16 IN**
[Jack]	**JK5**	**9 FT 2-5/8 IN**

Etc......Continue pressing [Jack] until last regular jack or "0." is reached.

---

* It is not necessary to keep on pressing [Conv] when displaying the Irregular Jack sizes.

Stair Problems (Risers/Treads)

The *Construction Master IV* easily computes the various values pertaining to stair building. Given values for total rise, total run and a *desired stair riser height*, your calculator will compute the following with the press of the [Stair] key:

1) **Number of Risers**
2) **Riser Height**
3) **Underage/Overage for Risers**
4) **Number of Treads**
5) **Tread Width**
6) **Underage/Overage for Treads**
7) **Stringer (Carriage) Length**
8) **Inclination Angle**
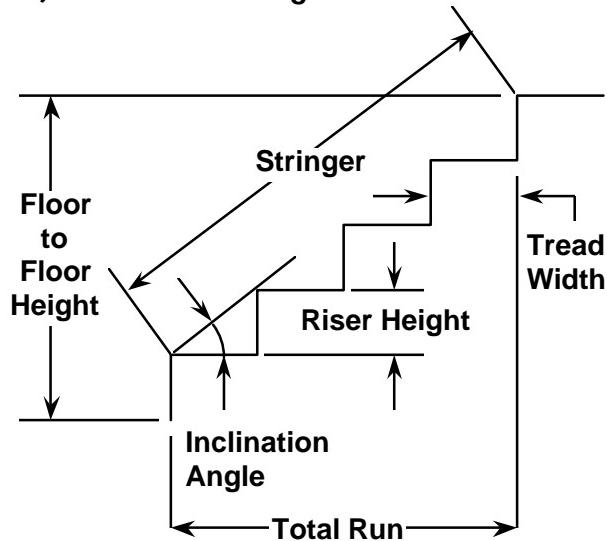
The *desired stair riser height* (default = 7-1/2) inches can be permanently revised by entering the new height and pressing [Stair].

Risers Only — Custom Height

You're building an access stairway for a client who can't handle conventional-height risers. If the total rise is 3 feet 8-3/4 inches and your *desired riser height* is approximately 5-1/2 inches, find the number of stair risers, actual riser height, and any underage or overage remaining.

Keystroke	Display
[On/C] [On/C]	**0.**

1. Enter Rise and Riser Height

3 [Feet] 8 [Inch]	
3 [/] 4 [Rise]	**RISE 3 FT 8-3/4 IN**
5 [Inch] 1[/] 2 [Stair]	**R-HT 5-1/2 IN**

2. Find Stair Values

[Stair]	**RSRS 8**
[Stair]	**R–SZ 5-5/8 IN**
[Stair]	**R+/– – 0-1/4 IN**
[Conv] [x] *(Optional)* *	**0.**

---

* An ALL CLEAR is performed here to set the calculator to its default settings.

Risers & Treads —
(*7-1/2 Inch Desired Riser Height*)

You need to build a stairway having a floor to floor height of 28 feet 5-1/2 inches, a run of 35 feet 6 inches and a nominal riser height of 7-1/2 inches (default). Find the number of risers, the riser height and underage/overage, the number of treads, the tread width and underage/ overage, stringer length and inclination angle.

Keystroke	Display
[On/C] [On/C]	**0.**

1. Enter Rise and Run

28 [Feet] 5 [Inch] 1 [/] 2	
[Rise]	**RISE 28 FT 5-1/2 IN**
35 [Feet] 6 [Inch] [Run]	**RUN 35 FT 6 IN**

2. Find Stair Values

[Rcl] [Stair]	**R-HT 7-1/2 IN**
[Stair]	**RSRS 46**
[Stair]	**R-SZ 7-7/16 IN**
[Stair]	**R+/– 0-5/8 IN**
[Stair]	**TRDS 45**
[Stair]	**T-SZ 9-7/16 IN**
[Stair]	**T+/– –1-5/16 IN**
[Stair]	**STRG 45 FT 1-3/8 IN**
[Stair]	**INC° 38.10298**

Circle Problems

Circumference and Area

Find the circumference and area of a circle having a diameter of 10 inches.

Keystroke	Display
[On/C] [On/C]	**0.**
10 [Inch] [Circ]	**DIA 10 IN**
[Circ]	**AREA 78.53982 SQ IN**
[Circ]	**CIRC 31-7/16 IN**
[Inch]	**31.41593 INCH**

Arc Lengths

Find the arc length of an 85° portion of a circle with a 5 foot diameter.

Keystroke	Display
[On/C] [On/C]	**0.**
5 [Feet] [Circ]	**5 FT 0 IN DIA**
85 [Conv] [Circ]	**3 FT 8-1/2 IN ARC**
[Feet]	**3.708825 FT**

APPENDIX A

Accuracy/Errors

Accuracy/Display Capacity — Your calculator has an eleven digit display made up of seven digits (normal display) and four fractional digits. Each calculation is carried out internally to 10 digits.

Errors — When an incorrect entry is made, or the answer is beyond the range of the calculator, it will display the word "Error." To clear an error condition you must hit the [On/C] button twice. At this point you must determine what caused the error and re-key the problem.

Auto-Range — If an "overflow" is created because of an input and calculation with small units that are out of the standard 7-digit range of the display, the answer will be automatically expressed in the next larger units (instead of showing "Error") — i.e., 10,000,000mm is shown as 10,000m. Also applies to inches, feet and yards.

Battery & Auto Shut-Off

Your calculator is powered by a single 3-Volt Lithium CR-2032 battery. This should last upwards of 800 hours of actual use (1 year plus for most people). Should the display become very dim or erratic, replace the battery.*****

Your calculator is designed to shut itself off after about 8-12 minutes of non-use.

Default Values

After a Full Reset/All-Clear, the calculator will return to the following settings:

Setting	Imperial	Metric
Stair Riser Height	7-1/2 Inch	185 mm
Raked Wall o.c.	16 Inch	600 mm
Jack o.c.	16 Inch	600 mm
Irregular Jack o.c.	16 Inch	600 mm
Weight per Vol.	1.5 Tons/Yd3	1775 kg/M3
Fractional Setting	1/16	1/16
Fractional Mode	Normal	Normal

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* WARNING: Please use caution when disposing of your old batteries as they contain hazardous chemicals.

APPENDIX B

Area Formulas
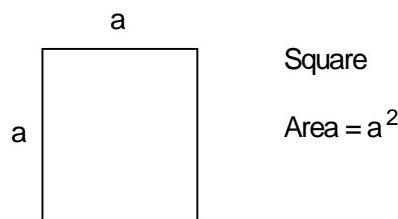
Square

$$\text{Area} = a^2$$
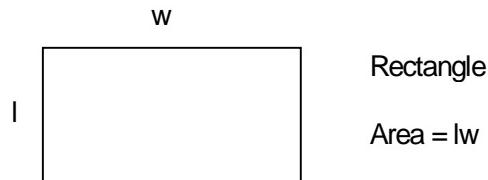
Rectangle

$$\text{Area} = lw$$
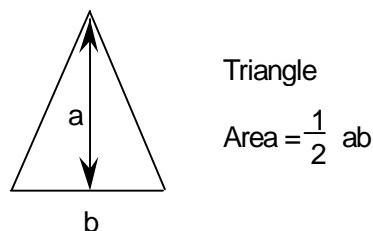
Triangle

$$\text{Area} = \frac{1}{2} ab$$
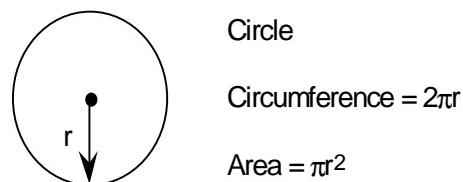
Circle

$$\text{Circumference} = 2\pi r$$

$$\text{Area} = \pi r^2$$
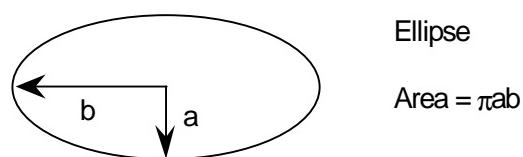
Ellipse

$$\text{Area} = \pi ab$$

# Surface Area & Volume Formulas
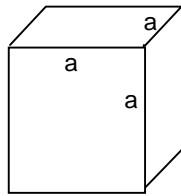
Cube

Surface area = $6a^2$

Volume = a^3
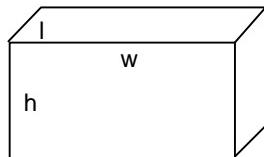
Rectangle

Surface area =
  $2hw + 2hl + 2lw$

Volume = l x w x h
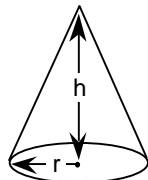
Cone

Surface area = $\pi r \sqrt{r^2 + h^2}$
($+\pi r^2$ if you add the base)

Volume = $\dfrac{\pi r^2 h}{3}$
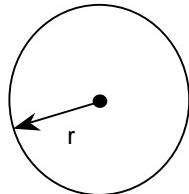
Sphere

Surface area = $4\pi r^2$

Volume = $\dfrac{4}{3}\pi r^3$
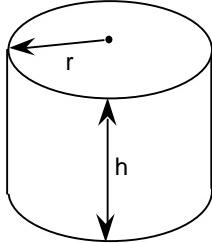
Cylinder

Surface area = $2\pi rh + 2\pi r^2$

Volume = $\pi r^2 h$

WARRANTY

Warranty Repair Service – U.S.A.

Calculated Industries, Inc. ("CII") warrants this product against defects in materials and workmanship for a period of one (1) year from the date of original consumer purchase in the U.S. If a defect exists during the warranty period, CII at its option will either repair (using new or remanufactured parts) or replace (with a new or remanufactured unit) the product at no charge.

THE WARRANTY WILL NOT APPLY TO THE PRODUCT IF IT HAS BEEN DAMAGED BY MISUSE, ALTERATION, ACCIDENT, IMPROPER HANDLING OR OPERATION, OR IF UNAUTHORIZED REPAIRS ARE ATTEMPTED OR MADE. SOME EXAMPLES OF DAMAGES NOT COVERED BY WARRANTY INCLUDE, BUT ARE NOT LIMITED TO, BATTERY LEAKAGE, BENDING, OR VISIBLE CRACKING OF THE LCD, WHICH ARE PRESUMED TO BE DAMAGES RESULTING FROM MISUSE OR ABUSE.

To obtain warranty service in the U.S., ship the product postage paid to the CII Authorized Service Provider listed on the back page of the User's Guide. Please pro-

vide an explanation of the service requirement, your name, address, day phone number and dated proof of purchase (typically a sales receipt). If the product is over 90 days old, include payment of $6.95 for return shipping and handling within the contiguous 48 states. (Outside the contiguous 48 states, please call CII for return shipping costs.)

A repaired or replacement product assumes the remaining warranty of the original product or 90 days, whichever is longer

Non-Warranty Repair Service – U.S.A.

Non-warranty repair covers service beyond the warranty period or service requested due to damage resulting from misuse or abuse.   Contact the CII Authorized Service Provider listed on the back page of the User's Guide to obtain current product repair information and charges. Repairs are guaranteed for 90 days.

Repair Service – Outside the U.S.A.

Not all countries have CII Authorized Service Providers or the same warranty and service policies. To obtain warranty or non-warranty repair service for goods purchased outside the U.S., contact the dealer through which you initially purchased the product. If you cannot reasonably have the

product repaired in your area, you may contact CII to obtain current product repair information and charges, including freight and duties.

Disclaimer

CII MAKES NO WARRANTY OR REPRESENTATION, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT'S QUALITY, PERFORMANCE, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE. AS A RESULT, THIS PRODUCT, INCLUDING BUT NOT LIMITED TO, KEYSTROKE PROCEDURES, MATHEMATICAL ACCURACY AND PREPROGRAMMED MATERIAL, IS SOLD "AS IS," AND YOU THE PURCHASER ASSUME THE ENTIRE RISK AS TO ITS QUALITY AND PERFORMANCE.

IN NO EVENT WILL CII BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECT IN THE PRODUCT OR ITS DOCUMENTATION.

The warranty, disclaimer, and remedies set forth above are exclusive and replace all others, oral or written, expressed or implied. No CII dealer, agent, or employee is authorized to make any modification, ex-

tension, or addition to this warranty.

Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific rights, and you may also have other rights which vary from state to state.

FCC Class B

This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC rules.

Looking For New Ideas

Calculated Industries, a leading manufacturer of special function calculators and digital measuring instruments, is always looking for new product ideas in these areas.

If you have one, or if you have any suggestions for improvements to this product or its User's Guide, please call or write our Product Development Department. Thank you.